Chapter 7
Methodology

ABSTRACT

This chapter uses intelligent methods based on swarm intelligence and artificial neural network to detect heart disorders based on electrocardiogram signals. This chapter has introduced the methodology undertaken in the denoising, feature extraction, and classification of ECG signals to four heart disorders including the normal heartbeat. It also presents denoising using intelligent methods.

7.1 INTRODUCTION

In this research, four heart disorders including bundle branch block, supraventricular tachycardia, anterior myocardial infarction (anterior MI) and inferior myocardial infarction (inferior MI), as well as normal ECG, will be classified using proposed intelligent method.

This chapter discusses the methodology to be employed in this research including the proposed method for classification as well as some related theory, with the implementation details given in the next chapter.

7.2 DATA COLLECTION

The biomedical research community uses the Physiobank archive of ECG signals (Physionet, 2012) for testing different studies. Since the collected signals are to be classified in the final stage of this project, having the correct

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classification of signals is necessary. Therefore, by consultation with heart specialist, 100 ECG signals were selected from three databases of Physiobank: the MIT-BIH Supraventricular Arrhythmia Database, the MIT-BIH Normal Sinus Rhythm Database, and the MIT-BIH Arrhythmia Database. The sampling frequency of the first two databases was 250 Hz, while the signals of the third database were sampled at 360 Hz.

The MIT-BIH Arrhythmia Database came into existence in 1980 for use in evaluating of detectors of arrhythmias, and it has become publicly available It was the first generally available collection of standard test signals and has become a worldwide standard Arrhythmia Database.

The Supraventricular Arrhythmia database includes the examples of supraventricular arrhythmias in the MIT-BIH Arrhythmia Database.

The normal Sinus Rhythm Database includes subjects referred to the Arrhythmia Laboratory at Boston's Beth Israel Hospital that were found to have had no significant arrhythmias; they include 5 men, aged 26 to 45, and 13 women, aged 20 to 50.

7.3 METHODOLOGY STAGES

A database of 100 lead II ECG signals were obtained from the Physiobank database. Figure 1 shows the simplified overall algorithm for the classification.

Preprocessing: The noise from powerline interferences, as well as motion artefacts from the electrode and skin interface, affect the QRS complex, P and T waves of the ECG signals. In the preprocessing, two intelligent approaches based on self-organising map (SOM) and PSO neural network (PSONN) for finding the cutoff frequency, are proposed and applied with one of the traditional models commonly used by many researchers (Losada, 2004; Orfanidis, 1996; Lian and Hoo, 2006; Engin, 2004; Minami et al., 1999; Lin et al., 2006; Naghsh-Nilchi and Kadkhodamohammadi, 2008). In this project, Finite Impulse Response (FIR) filter FIR is preferred to the infinite impulse

Figure 1. Flowchart of overall methodology for ECG classification